CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of MIG welding comprising:

providing ac power to a weld, wherein the ac power has a negative portion and a positive portion, and the ac power further has a frequency;

wherein the negative portion is greater than the positive portion;

wherein the frequency is at least 60 Hz.

2. The method of claim 1, wherein the frequency is between 90 Hz and 120 Hz.

3. The method of claim 1, further including providing a consumable, flux-cored, wire to the weld.

4. The method of claim 1, further including providing a consumable, metal-cored, wire to the weld.

5. The method of Claim 4, wherein providing the wire includes providing a wire wherein the wire comprises a sheath encapsulating a core having a core composition, the core composition comprising a combination of graphite and one or more compounds of potassium, the combination of graphite and compounds of potassium in the core composition not exceeding approximately 5% by weight.

6. The method of Claim 5, wherein providing the wire includes providing the wire electrode wherein the one or more compounds of potassium comprise K_2MnTiO_4.

7. The method of Claim 6, wherein providing the includes providing the wire wherein the combination is selected from the range from about 0.3% to about 5.0% by weight.

8. The method of claim 1, further comprising providing a weld path on at least one workpiece, wherein the weld path includes a groove having an angle of less than 50 degrees.

9. The method of claim 1, further comprising providing a weld path on at least one workpiece, wherein the weld path includes a groove having an angle of less than 30 degrees.

10. The method of claim 1, further comprising providing a weld path on at least one workpiece, wherein the weld path includes a groove having an angle of between 20 degrees and 30 degrees.

11. The method of claim 1, including welding at a rate of at least 35 pounds per hour using a single arc.

12. The method of claim 11 including welding at a rate of at least 40 pounds per hour.

13. The method of claim 11 wherein the negative portion is at least twice the positive portion.

14. The method of claim 10 wherein the negative portion is at least 1.5 times the positive portion.

15. The method of claim 1 wherein the weld process begins with a first negative portion having a duration of at least 0.5 seconds.

16. The method of claim 14 wherein the weld process begins with a first negative portion having a duration of at least 0.75 seconds.

17. The method of claim 1 further including providing a stick-out of about 2 inches.

18. The method of claim 17 further comprising providing a shielding gas at a rate of at least 80 cubic feet per hour.

19. A method of MIG welding comprising:

providing ac power to a weld, wherein the ac power has a negative portion and a positive portion, and the ac power further has a frequency; and

providing at least one workpiece with a weld path thereon, wherein the weld path includes a groove having an angle of less than 50 degrees.

20. The method of claim 19, wherein providing at least one workpiece includes providing the weld path with the groove having the angle between 20 degrees and 30 degrees.

21. The method of claim 19, wherein providing at least one workpiece includes providing the weld path with the groove having the angle less than 30 degrees.

22. The method of Claim 21, further comprising providing a wire comprising a sheath encapsulating a core

having a core composition, the core composition comprising a combination of graphite and one or more compounds of potassium, the combination of graphite and compounds of potassium in the core composition not exceeding approximately 5% by weight.

23. The method of Claim 22, wherein providing the wire includes providing the wire electrode wherein the one or more compounds of potassium comprise K_2MnTiO_4, and the combination is selected from the range from about 0.3% to about 5.0% by weight.

24. The method of claim 21 wherein:

the negative portion is greater than the positive portion; and

the negative portion is at least 1.5 times the positive portion.

25. The method of claim 24, wherein the frequency is between 90 Hz and 120 Hz.

26. The method of claim 24, further including providing a consumable, metal-cored, wire to the weld.

27. The method of Claim 24, further comprising providing a wire comprising a sheath encapsulating a core having a core composition, the core composition comprising a combination of graphite and one or more compounds of potassium, the combination of graphite and compounds of potassium in the core composition not exceeding approximately 5% by weight.

28. The method of Claim 27, wherein providing the wire includes providing the wire electrode wherein the one

or more compounds of potassium comprise K_2MnTiO_4, and the combination is selected from the range from about 0.3% to about 5.0% by weight.

29. A method of MIG welding comprising:

providing ac power to a weld having a negative portion and a positive portion, and the ac power further having a frequency; and

providing a consumable, cored, wire to the weld.

30. The method of claim 29 wherein the weld process begins with a first negative portion having a duration of at least 0.5 seconds.

31. The method of claim 29 wherein the weld process begins with a first negative portion having a duration of at least 0.75 seconds.

32. A method of MIG welding comprising:

providing ac power to a weld, wherein the ac power has a negative portion and a positive portion, and the ac power further has a frequency; and

providing a consumable wire to the weld at a rate of at least 35 pounds per hour using a single arc.

33. The method of Claim 32, wherein providing the wire further comprises providing a wire comprising a sheath encapsulating a core having a core composition, the core composition comprising a combination of graphite and one or more compounds of potassium, the combination of graphite and compounds of potassium in the core composition not exceeding approximately 5% by weight.

34. The method of Claim 33, wherein providing the wire includes providing the wire electrode wherein the one or more compounds of potassium comprise K_2MnTiO_4, and the combination is selected from the range from about 0.3% to about 5.0% by weight.

35. The method of claim 32, including providing a consumable to the weld at a rate of at least 40 pounds per hour.

36. The method of claim 35, further comprising providing the weld path on at least one work piece, wherein the weld path includes a groove having an angle of less than 30 degrees.

37. The method of claim 32 wherein the negative portion is at least twice the positive portion.

38. The method of claim 37 wherein the duration of the negative portion is at least 1.5 times the duration of the positive portion.

39. A method of MIG welding comprising:

providing ac power to a weld having a negative portion and a positive portion, and the ac power further having a frequency; and

wherein the negative portion is at least 1.5 times the positive portion.

40. The method of claim 39 wherein the duration of the negative portion is at least 1.5 times the duration of the positive portion.

41. The method of claim 39 wherein the weld process begins with a first negative portion having a duration of at least 0.5 seconds.

42. The method of claim 39 wherein the weld process begins with a first negative portion having a duration of at least 0.75 seconds.

43. A method of MIG welding comprising:

providing ac power to a weld, wherein the ac power has a negative portion and a positive portion, and the ac power further has a frequency;

wherein the negative portion is greater than the positive portion; and

wherein the weld process begins with the negative portion of at least 0.5 seconds duration.

44. The method of claim 43 wherein the weld process begins with a first negative portion having a duration of at least 0.75 seconds.

45. An apparatus for MIG welding a substrate of low carbon steel having a thickness of at least 1/2 inch comprising:

a table for holding the substrate;

a MIG gun;

a carriage for traversing the MIG gun over the substrate and providing a deposition rate of at least 30 pounds per hour;

a source of shielding gas disposed to provide the shielding gas to the MIG gun; and

a power source, connected to the MIG gun, capable of providing a substantially square AC current

at the MIG gun, with the average current being at least 300 amps.

46. A method of MIG welding comprising:

providing ac power to a weld, wherein the ac power has a negative portion and a positive portion, and the ac power further has a frequency;

wherein the negative portion has a negative amp-seconds and the positive portion has a positive amp-seconds, and further wherein the magnitude of the negative amp-seconds is greater than the magnitude of the positive amp-seconds; and

wherein the frequency is at least 60 Hz.

47. The method of Claim 46, further comprising providing a wire comprising a sheath encapsulating a core having a core composition, the core composition comprising a combination of graphite and one or more compounds of potassium, the combination of graphite and compounds of potassium in the core composition not exceeding approximately 5% by weight.

48. The method of Claim 47, wherein providing the wire includes providing the wire electrode wherein the one or more compounds of potassium comprise K_2MnTiO_4, and the combination is selected from the range from about 0.3% to about 5.0% by weight.

49. A MIG welding system comprising:

power means for providing ac power to a weld, wherein the ac power has a negative portion and a positive portion, and the ac power further has a frequency; and

control means for controlling the power means, wherein the negative portion has a negative amp-seconds and the positive portion has a positive amp-seconds, wherein the control means causes the negative amp-seconds to be greater than the positive amp-seconds, and wherein the frequency is at least 60 Hz.

50. The system of claim 49, wherein the control means includes means for providing the frequency to be between 90 Hz and 120 Hz.

51. The system of claim 49, further including a consumable, flux-cored, wire, disposed to be provided to the weld.

52. The system of claim 51, wherein the wire is metal-cored.

53. The system of claim 52, further comprising a weld path on at least one work piece, wherein the weld path includes a groove having an angle of less than 50 degrees.

54. The system of claim 49, further comprising a weld path on at least one workpiece, wherein the weld path includes a groove having an angle of less than 30 degrees.

55. The system of claim 54 wherein the control means for includes means for causing the negative amp-seconds to be at least twice the positive amp-seconds.

56. The system of claim 49 wherein the control means includes means for causing the negative amp-seconds to be at least 1.5 times the positive amp-seconds.

57. The system of claim 56 wherein the control means includes means for causing the weld process to begin with a first negative portion having a duration of at least 0.5 seconds.

58. The system of claim 49 wherein the control means includes means for causing the weld process to begin with a first cycle portion having a duration of at least 0.75 seconds.

59. A system of MIG welding arc comprising:

power means for providing to a weld ac power having a negative portion and a positive portion, and the ac power further having a frequency; and

means for providing a consumable, cored, wire to the weld.

60. The system of claim 59 wherein the power means includes means for beginning the weld process with a first negative portion having a duration of at least 0.5 seconds.

61. A system of MIG welding comprising:

power means for providing ac power to a weld, the ac power having a negative portion and a positive portion, and the ac power further having a frequency; and

means for controlling the power means such that the negative portion is at least 1.5 times the positive portion.

62. The system of claim 59 further comprising means for controlling the power means such that the weld

process begins with a first negative portion having a duration of at least 0.5 seconds.

63. A system of MIG welding comprising:

power means for providing ac power to a weld, wherein the ac power has a negative portion and a positive portion, and further has a frequency;

control means for controlling the power means such that the negative portion is greater than the positive portion, and further such that the weld process begins with the negative portion for at least 0.5 seconds.

64. A system of MIG welding comprising:

power means for providing ac power to a weld, wherein the ac power has a negative portion and a positive portion, and further has a frequency;

control means for controlling the power means such that the negative portion has a negative amp-seconds and the positive portion has a positive amp-seconds, and further wherein the magnitude of the negative amp-seconds is greater than the magnitude of the positive amp-seconds.

65. A system of MIG welding comprising:

an ac power source having a MIG output with a positive portion and a negative portion;

a controller controllably connected to the power source;

a feedback circuit disposed electrically between the power source and the controller;

a source of consumable wire, disposed to provide wire to the MIG output;

wherein the controller provides that the negative portion is greater than the positive portion, and further wherein the MIG output has a frequency of at least 60 Hz.

66. The system of claim 65, wherein the power source is a step-up cycloconverter and the frequency is between 90 Hz and 120 Hz.

67. The system of claim 65, wherein the wire is a flux-cored wire.

68. The system of claim 65, wherein the wire comprises a sheath encapsulating a core having a core composition, the core composition comprising a combination of graphite and one or more compounds of potassium, the combination of graphite and compounds of potassium in the core composition not exceeding approximately 5% by weight.

69. The system of Claim 68, the one or more compounds of potassium comprise K2MnTiO4.

70. The system of Claim 69, wherein the combination is selected from the range from about 0.3% to about 5.0% by weight.

71. The system of claim 67, further comprising providing a weld path on at least one work piece, wherein the weld path includes a groove having an angle of less than 50 degrees.

72. The system of claim 67, further comprising providing a weld path on at least one work piece, wherein

the weld path includes a groove having an angle of less than 30 degrees.

73. The system of claim 67 wherein the negative portion is at least 1.5 times the positive portion.

74. The system of claim 67 wherein the controller includes a start circuit, a control output and a timing circuit, that provides a negative portion having a duration of at least 0.5 seconds at the start of the weld process.

75. A system of MIG welding comprising:

a MIG torch;

an ac power source disposed to provide ac power to the MIG torch;

a source of consumable wire, disposed to provide wire to the MIG torch; and

wherein the wire comprises a sheath encapsulating a core having a core composition, the core composition comprising a combination of graphite and one or more compounds of potassium, the combination of graphite and compounds of potassium in the core composition not exceeding approximately 5% by weight.

76. The system of Claim 75, the one or more compounds of potassium comprise K_2MnTiO_4.

77. The system of Claim 76, wherein the combination is selected from the range from about 0.3% to about 5.0% by weight.

78. The system of claim 75 further comprising a controller operatively connected to the power source, and including a start circuit having a time delay and a control

output, wherein the weld process begins with a first negative portion having a duration of at least 0.5 seconds.

79. A system of MIG welding comprising:

an ac power source having a control input and a MIG output, wherein the MIG output has a negative portion and a positive portion;

a controller, including a balance circuit and a feedback circuit, operatively connected to the control input such that the negative portion is at least 1.5 times the positive portion.

80. A method of controlling dilution in MIG welding comprising:

providing ac power to a weld, wherein the ac power has a negative portion and a positive portion, and the ac power further has a frequency;

controlling the balance of the negative portion and the positive portion to obtain a desired dilution.

81. The method of claim 80 wherein the negative portion is greater than the positive portion.

82. The method of claim 80 wherein the negative portion is less than the positive portion.